

sas, and Louisiana, 19 days; Iowa, 17; Nebraska and Texas, 18; Illinois, 20; Missouri, 23.

**Auroras.**—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 12th to the 20th, inclusive. On the remaining twenty-one days of this month 228 reports were received, or an average of about 11 per day. The dates on which the number of reports of auroras for the whole country especially exceeded this average were: 1st, 86; 5th, 19; 23d, 30.

Reports were most numerous in: Michigan, 27; Minnesota, 23; New Hampshire and Ohio, 18; New York, 26; North Dakota, 35.

The number of reports was a large percentage of the number of observers in: North Dakota, 90; New Hampshire, 78; Minnesota, 33; Michigan and New York, 28.

#### CANADIAN REPORTS.

Thunderstorms were reported as follows: Father Point, 23d; Quebec, 23d; Montreal, 23d, 25th; Rockliffe, Toronto, Kingston, Port Stanley, 23d; Saugeen, 4th; Parry Sound, 24th; Port Arthur, 22d; Winnipeg, 18th, 24th.

Auroras were reported as follows: Halifax, 16th; Grand Manan, 24th; Yarmouth, 1st; St. Andrews, 20th; Father Point, 1st, 27th; Quebec, 1st, 3d, 23d; Montreal, 1st; Toronto, 1st; White River, 1st, 4th, 5th; Port Stanley, 1st; Saugeen, 1st; Port Arthur, 6th, 14th, 24th; Winnipeg, 1st, 2d, 4th, 7th, 20th, 23d, 24th; Minnedosa, 1st, 7th, 9th, 12th, 16th, 19th, 24th, 25th, 26th, 29th; Qu'Appelle, 16th; Medicine Hat, 23d, 24th, 27th; Calgary, 9th; Prince Albert, 2d, 16th, 24th, 30th; Battleford, 7th; Banff, 20th, 21st; Sable Island, 1st.

#### SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 22 regular stations of the Weather Bureau by its photographic, and at 37 by its thermal effects; at one of these stations records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table X for each hour of local mean time. In order to complete the record of the duration of cloudiness these registers are supplemented by special personal observations of the state of the sky near the sun in the hours after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence there results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table X.

#### COMPARISON OF DURATIONS AND AREAS.

The sunshine registers give the *durations* of effective sunshine whence the durations relative to possible sunshine are derived; the observers' personal estimates give the percentage of *area* of clear sky. These numbers have no necessary relation to

each other, since stationary banks of clouds may obscure the sun without covering the sky, but when all clouds have a steady motion past the sun and are uniformly scattered over the sky, the percentages of duration and of area agree closely. For the sake of comparison, these percentages have been brought together, side by side, in the following table, from which it appears that, in general, the instrumental records of percentages of durations of sunshine are almost always larger than the observers' personal estimates of percentages of area of clear sky; the average excess for April, 1897, is 9 per cent for photographic and 8 per cent for thermometric records.

The details are shown in the accompanying table, in which the stations are arranged according to the *total possible* duration of sunshine, and not according to the *observed* duration.

#### Difference between instrumental and personal observations of sunshine.

Stations.	Latitude.	Apparatus.	Total possible duration for the whole month.	Personal estimated area of clear sky.	Instrumental record of sunshine.			
					Photographic.	Difference.	Thermometric.	Difference.
Tampa, Fla.....	0	P.	385.4	50	50	0	54	+ 4
Galveston, Tex.....	28 18	P.	386.4	54	72	+ 8	32	0
New Orleans, La.....	29 58	P.	387.4	53	61	+ 8	78	+ 3
Savannah, Ga.....	32 08	P.	389.9	75	76	+ 1	70	+ 9
Vicksburg, Miss.....	32 43	P.	389.9	61	59	+ 6	59	+ 5
San Diego, Cal.....	32 47	P.	390.5	61	80	+ 11	68	+ 7
Charleston, S. C.....	32 59	P.	390.5	59	68	+ 11	68	+ 7
Phoenix, Ariz.....	33 28	P.	391.6	69	68	+ 11	68	+ 7
Atlanta, Ga.....	33 45	P.	391.6	62	78	+ 11	76	+ 13
Los Angeles, Cal.....	34 03	P.	391.6	62	78	+ 11	60	+ 6
Wilmington, N. C.....	34 14	P.	391.6	62	78	+ 11	93	+ 5
Little Rock, Ark.....	34 45	P.	392.7	47	54	+ 7	54	+ 7
Chattanooga, Tenn.....	35 04	P.	393.6	62	78	+ 11	76	+ 13
Santa Fe, N. Mex.....	35 41	P.	393.6	57	57	0	60	+ 6
Raleigh, N. C.....	35 45	P.	393.6	54	54	0	60	+ 6
Nashville, Tenn.....	36 10	P.	393.6	54	54	0	60	+ 6
Fresno, Cal.....	36 43	P.	394.8	58	58	0	60	+ 6
Dodge City, Kans.....	37 45	P.	396.2	57	66	+ 9	54	+ 7
San Francisco, Cal.....	37 48	P.	396.2	70	70	0	81	+ 11
Louisville, Ky.....	38 15	P.	396.2	40	40	0	55	+ 15
St. Louis, Mo.....	38 38	P.	397.0	38	38	0	52	+ 14
Washington, D. C.....	38 54	P.	397.0	60	67	+ 7	60	+ 7
Kansas City, Mo.....	39 05	P.	397.0	40	48	+ 8	49	+ 5
Cincinnati, Ohio.....	39 06	P.	397.0	44	44	0	49	+ 5
Baltimore, Md.....	39 18	P.	397.0	55	55	0	54	+ 1
Atlantic City, N. J.....	39 22	P.	397.0	57	70	+ 13	50	+ 11
Denver, Colo.....	39 45	P.	398.6	51	60	+ 18	50	+ 11
Indianapolis, Ind.....	39 46	P.	398.6	30	30	0	72	+ 21
Philadelphia, Pa.....	39 57	P.	398.6	51	51	0	72	+ 21
Columbus, Ohio.....	39 58	P.	399.4	30	30	0	43	+ 5
Pittsburg, Pa.....	40 32	P.	399.4	38	38	0	76	+ 18
New York, N. Y.....	40 43	P.	399.4	58	58	0	73	+ 15
Salt Lake City, Utah.....	40 46	P.	399.4	50	67	+ 17	40	0
Eureka, Cal.....	40 48	P.	399.4	51	60	+ 9	40	0
Cheyenne, Wyo.....	41 08	P.	399.4	53	60	+ 8	40	0
Omaha, Nebr.....	41 16	P.	399.4	41	50	+ 9	40	0
Cleveland, Ohio.....	41 30	P.	401.1	36	36	0	32	+ 6
Des Moines, Iowa.....	41 35	P.	401.1	44	44	0	47	+ 3
Chicago, Ill.....	41 53	P.	401.1	46	46	0	49	+ 3
Erie, Pa.....	42 07	P.	401.1	40	40	0	46	+ 6
Binghamton, N. Y.....	42 08	P.	401.1	42	42	0	48	+ 6
Detroit, Mich.....	42 20	P.	401.1	33	33	0	41	+ 8
Boston, Mass.....	42 21	P.	401.1	50	50	0	57	+ 7
Dubuque, Iowa.....	42 30	P.	401.1	49	49	0	44	+ 5
Albany, N. Y.....	42 39	P.	401.1	38	38	0	38	0
Buffalo, N. Y.....	42 53	P.	401.1	30	30	0	50	+ 20
Rochester, N. Y.....	43 08	P.	402.1	44	44	0	47	+ 3
Idaho Falls, Idaho.....	43 29	P.	402.1	72	72	0	64	+ 8
Portland, Me.....	43 39	P.	403.6	49	49	0	63	+ 14
Northfield, Vt.....	44 10	P.	403.6	35	46	+ 11	40	0
Eastport, Me.....	44 54	P.	405.2	37	45	+ 8	40	0
St. Paul, Minn.....	44 58	P.	405.2	46	53	+ 7	40	0
Minneapolis, Minn.....	44 59	P.	405.2	40	40	0	38	0
Portland, Ore.....	45 32	P.	407.0	60	60	0	61	+ 1
Helena, Mont.....	46 34	P.	408.4	60	65	+ 5	40	0
Bismarck, N. Dak.....	46 47	P.	408.4	41	45	+ 4	40	0
Seattle, Wash.....	47 38	P.	410.4	57	57	0	57	0
Spokane, Wash.....	47 40	P.	410.4	43	43	0	43	0

\* Instrument out of order.

+ 26 days only; the total possible for 30 days is 402.1; personal estimate, 33 per cent.